

## **System Specification**

### **Data Distribution Completion Thread, Thor DP1**

### **Checkout and Launch Control System (CLCS)**

**84K00302-003**

# Data Distribution Completion Thread Assessment

March 17, 1998

Version 1.0

## **1. Introduction**

### **1.1 Data Distribution Completion Thread Overview.**

The Thor Data Distribution Completion Thread is a continuation of the Redstone Data Distribution Thread. It provides the completion of support for end-to-end data flow of FDs. End-to-end FD's data flow provides the mechanism for the system to move data values between most elements of the CLCS, which include the DDPs, CCPs, HCIs, and SDCs, and supports retrieval of FD data by user applications and user displays.

The focus of the Data Distribution Completion Thread is on performance enhancement, providing FD write support, providing System Integrity support, and providing test tools for testing and debugging purposes.

### **1.2 Data Distribution Thread Concept**

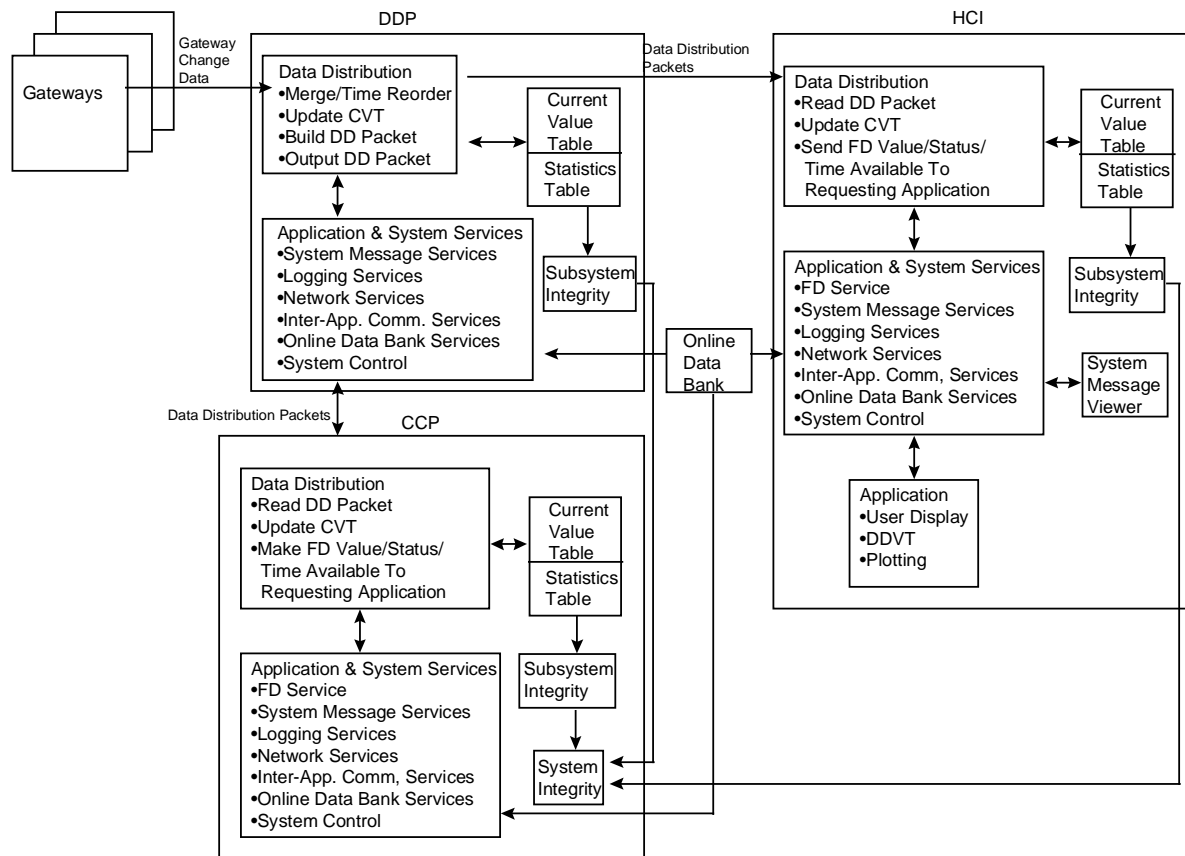
The Data Distribution Thread spans from the point where data is received at the Data Distribution Processor (DDP) from the RTCN, to the point where data is retrieved by user applications and/or user displays. Data received from the RTCN include:

- Gateway change data
- Application derived measurements

The data received is processed at the DDP. Processing includes merging and time re-ordering, applying data health, adding display attributes, and finally outputting the data to RTCN at the system synchronous rate, and to the DCN at the display synchronous rate.

Part of the Data Distribution Thread runs in the Command and Control Processor (CCP), where data is read from the RTCN and made available to Command applications, and end-item managers on an FD parameter basis.

The end point of the Data Distribution Thread is at the HCI workstations, where FD values and attributes can be retrieved by the user applications and/or user displays. Note that the processing in the CCP and HCI is very similar and should be driven by the same pieces of software. The HCI end of the thread also consists of FD viewers, from which users will be able to view data values and attributes associated with one or more FDs.

**Data Distribution and Processing Thread - Concept Diagram**

### 1.3 Data Distribution Completion Thread Specification

#### Highlights

- Provide performance data for system modeling.
- Confirm and/or modify system data flow [diagrams](#) for FD Data Distribution [and provide the appropriate updates to the SDD.](#)
- Provide the capability for the Data Distribution function to be utilized in both Operational and application development configurations.
- Add support for Application Change Data.

#### 1.3.1 Statement Of Work

##### DDP Data ~~Merger~~ Function

- Collect Application Change Data packets from all CCPs at System Synchronous rate.
- [Collect Application Change Data packets from HCIs on demand.](#)
- Merge Gateway Change Data and Application Change Data in to a single a stream.
- Place requested FDs in queues for the ~~Data-Constraint-Function~~ [Constraint Manager](#).
- Define and provide a method to send System Default FD Display Attribute (dynamic limits and animation).
- Maintain statistics on packet rates [and](#) data rates, ~~and CPU utilization.~~

##### CCP Data Function

- Provide an output queue for user Application Derived FDs and transmit them to the DDP at System synchronous rate.
- Define and provide a method to send System Default FD Display Attribute.
- Place requested FDs in queues for the ~~Data-Constraint-Function~~ [Constraint Manager](#).

##### [HCI Data Function](#)

- [Provide the capability for applications at the HCI to set FD values and/or display attributes.](#)

##### SDC Data Function

- For debug use – Record raw Gateway Change Data Packets from all gateways and Application Change Data Packets from all CCPs on the RTCN.

##### General

- Maintain statistics on packet rates, data rates, and errors. ~~and CPU utilization.~~
- Provide performance data for system modeling.
- Confirm and or modify system data flow [diagrams](#) for FD Data Distribution, [and provide the appropriate updates to the SDD.](#)
- Provide the capability for the Data Distribution function to be utilized in both Operational and [application development Test-Bed](#) configurations.
- Provide logging of error, performance, and state change information.
- Baseline system messages using the System Message Catalog to include message and help text.
- [Support FD override capability.](#)

#### 1.3.2 Requirements

#### Performance Requirements from SLS

- 1.3.2.1.1 The “system maximum data bandwidth” shall support 25,000 end item changes per second continuously.
- 1.3.2.1.2 The system shall support 50,000 end item measurement changes in a given second without losing any data.
- 1.3.2.1.3 The system shall support 1,000 end item measurement changes during a 10 millisecond period.
- 1.3.2.1.4 One user’s test applications shall be able to read 10,000 measurements, and “verify” them in a single second in an unloaded system.
- 1.3.2.1.5 The data distribution function shall support the “system maximum data bandwidth”, plus 5,000 (20%) Data Fusion updates per second.
- 1.3.2.1.6 The time from a measurement change being detected by the system until that measurement is available for retrieval shall be less than five seconds. (2.2.2.1.12)

#### **Other Data Distribution Related Requirements from SLS**

- 1.3.2.1.7 The RTPS shall maintain the current value of all Measurement FDs for access by application SW. (2.2.3.1.3)
- 1.3.2.1.8 The RTPS shall provide the capability for applications to request all changes of a selected set of Measurement FDs and have them provided along with time of change and health at the time of change. (2.2.3.1.4)
- 1.3.2.1.9 The RTPS shall provide changed measurement data to system and user applications at the System Synchronous Rate. (2.2.3.1.5)
- 1.3.2.1.10 The RTPS shall provide changed measurement data to display applications at the Display Synchronous Rate.
- 1.3.2.1.11 CLCS shall provide the user the capability to create Pseudo FDs and generate their values using Test Applications.
- 1.3.2.1.12 CLCS shall provide the capability for Pseudo FD values to be persistent between different tests.
- 1.3.2.1.13 CLCS shall provide the user the capability to choose which Pseudo FDs are to be persistent.

#### **High level derived requirements**

- 1.3.2.1.14 Data Distribution shall provide an application interface allowing an application to assign the following to a FD or a list of FDs:
- Data value
  - Display attribute
- 1.3.2.1.15 Data Distribution shall provide a mechanism to collect the changed Application Derived FDs into an Application Change Data packet at the CCP and send the packet to Data Distribution at the DDP.
- 1.3.2.1.16 Data Distribution shall sent the “set FD value/display attribute” request at the HCI upon request.

1.3.2.1.17 Data Distribution shall receive Application Change Data Packets at the DDP.

1.3.2.1.18 Data Distribution shall collect Application Change Data packets received from all the CCPs and update the CVT with the changed data.

1.3.2.1.19 Data Distribution shall include the changed Application Derived FD's in the Data Distribution packets at the DDP and output to the RTCN and DCN.

1.3.2.1.20 Data Distribution shall support processing of data in a Time Homogenous Data Set.

1.3.2.1.21 Data Distribution shall notify Subsystem Integrity immediately whenever a failure occurs that causes Data Distribution to cease processing change data.

1.3.2.1.22 Data Distribution shall provide an application program interface (API) for Subsystem Integrity to obtain the following information:

- Overall health of Data Distribution
- Error situations (e.g. Failure to setup Network communication; errors that cause Data Distribution to terminate.)
- Statistics on packet size and data rate

1.3.2.1.23 Data Distribution shall incorporate Constraint Notifications in the RTCN Data Distribution packets. (Note: This is a potential requirement to be levied on Data Distribution by Constraint Manager.)

1.3.2.1.24 Data Distribution shall generate the following test tools:

- The capability to construct and feed data streams to Data Distribution residing on the same platform. The number of streams and contents of the data streams will be based on FD names, values and rates defined in an ASCII file.
- An interactive tool that allows the user to:
  - Subscribe to a list of FDs and display values on the screen.
  - Publish a list of FDs at specific rate
  - Retrieve the packets from the DCN or RTCN and print the header time, length of packet and number of packets being sent.
- Capability to display the DDP CVT content at an HCI.
- Capability to display the Data Distribution statistics at an HCI.

## 1.4 Data Distribution Completion Thread Hardware Diagram

Not Applicable.

## 1.5 Data Distribution Completion Thread Deliverables

| Deliverable   | R&D Document | Code | API Manual | Users Guide |
|---|--------------|------|------------|-------------|
| Data Distribution & Processing<br>- Data Distribution CSC | X            | X    | X          | N/A         |
| Application Services                                      | X            | X    | X          | N/A         |
| System Control  | X            | X    | X          | X           |
|   |              |      |            |             |

## 1.6 Data Distribution Completion Thread Assessment Summary

This section contains the summary of the costs and labor involved in implementing the Data Distribution Completion Thread capabilities. It is broken into three sections. The first is a summary of the individual CI (CSCI and HWCI) labor assessments. The second is a summary of hardware costs. The third is a summary of procurement activities needed.

### 1.6.1 Labor Assessments

The total Labor Costs required to provide this capability are summarized in the following table:

| No. | CSCI/HWCI Name   | Thor LM | Changes covered in                              |
|-----|--|---------|---|
| 1   | Data Distribution Processing CSCI<br>- Data Distribution CSC | 19 LM   | Data Distribution Completion Thread             |
| 2   | Application Services CSCI                                    | 5 LM    |   |
| 3   | CS Gateway CSCI  | 0       | End to End Gateway Data<br>Demonstration Thread |
| 4   | System Control CSCI  | 0       | Covered by the System Services Thread           |
| 5   | Test Build and Control                                       | 2 LM    |   |
|     | TOTAL  | 26 LM   |   |

### 1.6.2 Hardware Costs

None.

### 1.6.3 Data Distribution Completion Thread Procurement

None.

1.7



## Data Distribution Completion Thread Schedule & Dependencies

### 1.7.1 Schedule

| Task Name                               | Start    | Finish   |
|---|----------|----------|
| Thor Assessment Kickoff                 | 07/23/97 | 07/23/97 |
| Concept Panel Internal Review           | 08/26/97 | 08/26/97 |
| Concept Panel                           | 08/28/97 | 08/28/97 |
| <b>Thor Development</b>                 |          |          |
| Requirement Panel Internal Review       | 09/30/97 | 09/30/97 |
| Requirement Panel                       | 10/02/97 | 10/02/97 |
| Design Panel Internal Review            | 10/28/97 | 10/28/97 |
| Design Panel                            | 10/30/97 | 10/30/97 |
| CSCI Unit Testing                       | 01/02/98 | 01/09/98 |
| CSCI Development Integration Test (UIT) | 01/12/98 | 01/23/98 |
| CSCI Formal Integration Test (CIT)      | 01/26/98 | 01/30/98 |
| Support System Integration Test         | 02/23/98 | 03/27/98 |
| Thor Development Complete               | 03/27/98 | 03/27/98 |

### 1.7.2 Dependencies

The following dependencies are essential to the UIT and CIT schedule listed on the above section:

| No. | Dependency Area             | Dependency  | Need Date            |
|-----|-----------------------------|---|----------------------|
| 1   | Application Services        | <ul style="list-style-type: none"> <li>OLBD read library for psuedo FD support</li> <li>FD Services API to support assigning data values and display attributes to FDs for end-to-end testing purpose.</li> </ul>   | 12/01/98<br>01/12/98 |
| 2   | CS Gateway                  | Needed for performance tuning and Thor development testing: <ul style="list-style-type: none"> <li>Upgrade to the Data Generator to support a minimum of 20 streams. (2 synchronized Data Generators, each generating 10 streams will suffice). 3 of the streams will be the GSE, PCM and LDB streams.</li> <li>The capability to be able to add two test FDs and set the value of the FD's with a predefined algorithm.</li> <li>Include THDS in the PCM data stream.</li> </ul> | 11/15/97             |
| 3   | System Control              | PPT API to support gateways assigned to the configured activity. (Stubs with hardcoded values will be acceptable for 1/02/98 version. Real capability is needed by 1/12/98 along with the Remote platform configuration capability.)  | 01/02/98             |
| 4   | System Control              | Remote platform configuration/initialization capability that include gateway(s) as part of activity definition.   | 01/02/98             |
| 5   | Network Services            | Thor version of Reliable Message @ SDE-JSC  | 12/15/97             |
| 6   | DBSAFE Test Build & Control | TCID with THDS and a representative set of Data Distribution pseudo FDs for testing purposes  | 12/15/97             |
| 7   | Constraint Manager          | Potential capability to pass constraint notifications to Data Distribution to be included in the DD packets output to the RTCN.   | 01/12/98             |
| 8   | SDE-JSC                     | Target Network available at SDE-JSC facility.   | 12/15/97             |

## 1.8 Data Distribution Completion Thread Simulation Requirements

A Data Generator upgrade is needed for simulation:

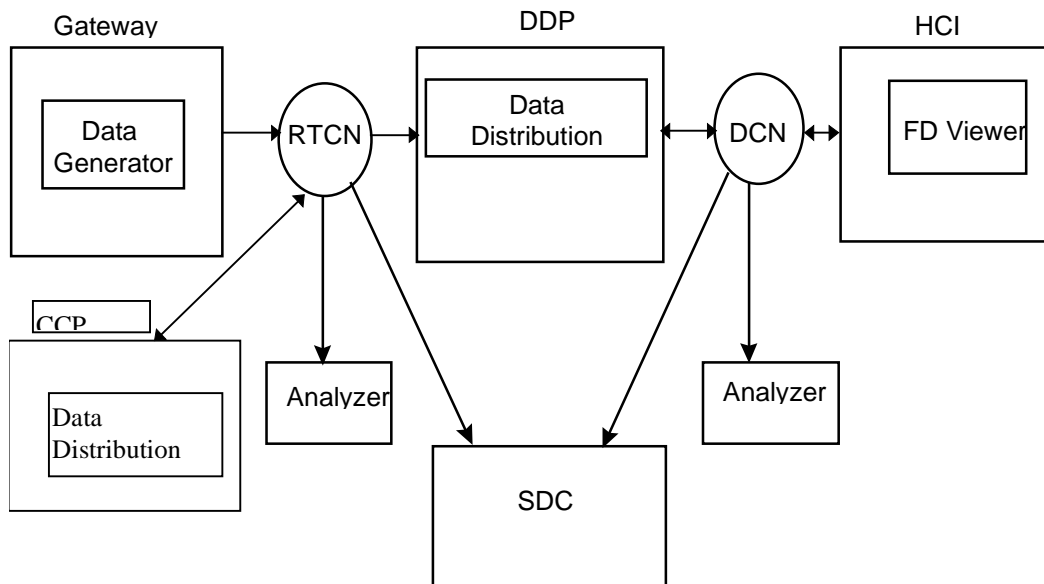
- Capability to support a minimum of 20 streams - 3 of the streams will be GSE, PCM and LDB.
  - THDS included in the PCM data stream
- Capability to add a minimum of two FDs and set the value of the FDs with a predefined algorithm

## 1.9 Data Distribution Completion Thread Integration and System Test

Data Distribution end-to-end development testing will be performed prior to start of System Test:

- Data Generator provided by the CS Gateway will be used to generate a predefined and representative set of FD values/statuses.
- LAN analyzer will be used on the Network to track data rates.
- FD viewers will be used to visually verify FD data received at the HCIs.
- SDC recorded data will be used to verify FD data sent and received across the Network.
- Messages written to DDP local log and System messages sent to the HCIs will be used for debug and verification purposes.

System test plan and test procedures will be prepared by the System Test Organization.



## 1.10 Data Distribution Completion Thread Training Requirements

None.

### 1.10.1 Training Needed

Training to be provided to the Data Distribution CSCI developers on the upgraded Data Generator will be needed.

### 1.10.2 Training to be provided

Training on using the Data Distribution APIs can be provided upon request.

## 1.11 Data Distribution Completion Thread Facilities Requirements

Additional/replacement resources will be needed by the Data Distribution Thread for SDE-JSC facility:

- 1 CCP (O2)
- 4 HCI workstations (The 9 O2's available at SDE-JSC are being shared between System Services and System Control. The 4 additional O2's that were approved at Redstone DP1 were never delivered to SDE-JSC).
- Target Network (to replace the current ATM network)

## 1.12 Travel Requirements

This section contains a list of travel requirements. If there are none, the section should state none.

| From    | To  | Reason   | No. People | Duration | Est. Date or Frequency |
|---------|-----|--|------------|----------|------------------------|
| Houston | KSC | Support of Design Panels by Houston developers/management            | 2          | 3 days   | 3 trips                |
| Houston | KSC | On-site integration testing and system testing by Houston developers | 2          | 3 weeks  | 1 trip                 |
| Houston | KSC | On-site training for developers/management                           | 1          | 1 week   | 1 trip                 |

## 1.13 Data Distribution Completion Thread Action Items/Resolution

1. When an application assigns a data value or display attribute to an FD, an authentication check is required to verify that the application has the authority to do so. The Data Distribution CSCI will provide the capability to assign a data value or display attribute to an FD upon request, but the authentication check will be done in the FD Services layer. The mechanism of how this is accomplished needs to be addressed.

**Status:** Submitted as ERP issue.

2. The definition and representation of display attribute, as well as how it will be utilized by applications and users need to be defined.
3. The duration of persistence for pseudo FD values need to be defined. How (predefined vs. Real time, or both) and where (TCID vs. Data Distribution, or both) also need to be worked.
4. Should applications residing at the HCI be allowed to assign data value and/or display attribute to FDs? If so, should the data be collected and send to the DDP at SSR or DSR?

**Resolution:** Applications residing at the HCI will be allowed to assign data value and/or display attribute to FDs. Unlike the requests made at the CCP, which will be accumulated and sent to the DDP at SSR, the request from the HCIs to set FD will be sent to the DDP as soon as the request is made.

5. Currently there is no statement of work for overriding FD values and "commanding" FDs processing (e.g. inhibit FD processing). Are these capabilities needed in the CLCS environment?

**Partial Resolution:** The capability to override FD values has been added to the SOW. Issue on subsystem commands is still open.

## 2. CSCI Assessments

This section is provided for the individual CSCI leads to fill in and provide the details of their assessments. The lead should use this information to provide the summaries in section 1. The details are not presented in any of the panels unless needed by the presenter as backup.

### 2.1 Data Distribution & Processing CSCI Assessment

The following capabilities will be provided by the Data Distribution CSCI in support of the Data Distribution Thread:

#### Data Distribution CSC Name 1 Work Required

The Data Distribution CSC will be enhanced to support the following:

##### Application Derived FDs Support

- Provide an application interface allowing an application to assign the following to a FD or a list of FD's
  - Data value
  - Display attribute
- Provide a mechanism to collect the changed Application Derived FDs into an Application Change Data packet at the CCP and send the packet to the DDP.
- Provide a mechanism to send a "Set FD value/attribute" request from HCIs to the DDP upon request.
- Receive Application Change Data Packets at the DDP.
- Collect Application Change Data packets received from all the CCPs and update the CVT with the changed data.
- Include the changed Application Derived FD's in the Data Distribution packets at the DDP and output to the RTCN and DCN to be distributed to the CCP and HCIs.

##### System Integrity Support

- Notify Subsystem Integrity immediately whenever a failure occurs that causes Data Distribution to cease processing change data.
- Provide an application program interface (API) that allows Subsystem Integrity to obtain the following information:
  - Overall health of Data Distribution
  - Statistics on packet size and data rate
  - Error situations (e.g. Failure to setup Network communication; errors that cause Data Distribution to terminate).

##### THDS Support

- Support processing of Time Homogenous Data Set (THDS).

##### Performance Tuning

- If needed, optimize the code to meet the SLS performance requirements.
- Tune the system for better performance result.

##### Constraint Manager Support

- Incorporate Constraint notifications in the RTCN Data Distribution packets.

##### Test Tools

- Provide test tools for diagnostic and testing purposes in a single box environment
  - The capability to construct and feed data streams to Data Distribution residing on the same platform. The number of streams and contents of the data streams will be based on FD names, values and rates defined in an ASCII file.
  - An interactive tool that allows the user to:
    - Subscribe to a list of FDs and display values on the screen.
    - Publish a list of FDs at specific rate

- Retrieve the packets from the DCN or RTCN and print the header time, length of packet and number of packets being sent.
- Capability to display the DDP CVT content at an HCI.
- Capability to display the Data Distribution statistics at an HCI.

#### Application Development Support

- Ensure that Data Distribution will be able to run in a “CLCS in a box” type of application development environment.

#### System Message Enhancement

- Provide help information for each Data Distribution System Message
- Integrate help information into System Message catalog

#### System Test Support

- Provide developer support for generation of System Test Procedures, hands-on training and problem isolation during System Test.

#### CSCI Assessment

**Note:** The cost assessment for Constraint Manager will be covered by the Constraint Manager Phase 1 Thread.

| CSC Name                                      | CSC Labor (LM) | % of CSC |
|---|----------------|----------|
| Data Distribution CSC                         |                |          |
| ■ Application Derived FDs support             | 4 LM           |          |
| ■ Performance Tuning                          | 2 LM           |          |
| ■ THDS Support                                | 4 LM           |          |
| ■ System Integrity Support                    | 3 LM           |          |
| ■ Test Tools                                  | 3 LM           |          |
| ■ Application Development Environment Support | 1 LM           |          |
| ■ DD System Message Enhancement               | 1 LM           |          |
| ■ System Test Support                         | 1 LM           |          |
| <b>TOTAL</b>                                  | <b>19 LM</b>   |          |

#### Basis of estimate

Estimate is based on a combination of the following:

- Source lines of code - code additions will be interspersed among existing code, which means any addition will require some amount of analysis to ensure that the addition is compatible with and not impacting the existing software.
- Complexity factor
- Amount of integration testing needed

#### Documentation

| Document Type                         | New/Update | Number of Pages |
|---------------------------------------|------------|-----------------|
| Requirements and Design Documentation | Update     | 20              |
| Users Guide                           | N/A        | N/A             |
| API Interface Document                | Update     | 5               |
| Interface Design Document             | N/A        | N/A             |
| Test Procedure                        | Update     | 20              |

**Assumptions**

Refer to the Data Distribution Completion Thread Action Items and Resolution Section (Section 1.13).

**Open Issues**

Refer to the Data Distribution Thread Action Items/Resolution items in Section 1.13.

**2.2 Application Services CSCI Assessment**

Applications Services provides a layer for access to data stored in the Current Value Table (CVT). Applications Services also provides access to underlying data files needed by Data Distribution CSC during its initialization.

**Function Designator Services (FDS) Work Required:**

- Provide access to members of Time Homogeneous Data Sets (THDS). Provide access to groups of THDS.
- Provide status related to homogeneity of THDS (good data/questionable or bad data).
- FDS (and User Display Services (UDS)) will provide the capability to override the value of an FD. [The override capability will last for one cycle unless data flow from the gateway has been otherwise inhibited.]
- Provide an API to allow a user to mark all data associated with a Gateway as good or bad.

**User Display Services Work Required:**

- FDS (and User Display Services (UDS)) will provide the capability to override the value of an FD. [The override capability will last for one cycle unless data flow from the gateway has been otherwise inhibited.]
- Provide an API to allow a user to mark all data associated with a Gateway as good or bad.

**Applications Services Assessment**

| CSC Name    | CSC Labor | % of CSC |
|-------------|-----------|----------|
| FD Services | 3         |          |
| UD Services | 1         |          |
| Total       | 4         |          |

**Basis of estimate**

Estimate is based on Redstone experience.

**Documentation**

| Document Type                         | New/Update | Number of Pages |
|---------------------------------------|------------|-----------------|
| Requirements and Design Documentation | New        | 20              |
| Users Guide                           | N/A        |                 |
| API Interface Document                | New        | 10              |
| Interface Design Document             | N/A        |                 |
| Test Procedure                        | New cases  | 30              |

**Other:****Assumptions**

- ASV will not provide access to the reserved word fields (one of which is referred to as “display attribute”) in the DD panel presentation.

- DD provides the logic and initiative to appropriately mark the health bits and reason code(s) for data when the data's supporting gateway goes down or comes back up. No ASV support is required for this function when DD executes it.

### Open Issues

Assessment Provided By: Julia Samson, ASV CSCI Lead, 1-2212

## 2.3 CS Gateway CSCI Assessment

The Data Generator will be upgraded to support a minimum of 20 streams.

### CSCI Assessment

The cost assessment for this CSCI will be covered in the End to End Gateway Data Demonstration Thread.

## 2.4 System Control CSCI Assessment

The system Control CSCI will provide Gateway stream names supported for a specified activity to be part of the Platform Parameter Table (PPT) data.

The cost assessment is covered by the System Services Thread.

## 2.5 Network Services CSCI Assessment

The Reliable Message capability to be updated to support the Thor target Network.

### CSCI Assessment

The assessment for the updated Reliable Message capability will be covered under the Reliable Message Completion Thread.

## 2.6 Test Build and Control Assessment

Test Build and Control will create the required files for Time Homogeneous Data Set processing. Test Build and Control will also incorporate a converted type and converted length in the OLDB.

### CSCI Assessment

#### Example:

| CSCI Name              | CSCI Labor (LM) | % of CSCI |
|------------------------|-----------------|-----------|
| Test Build and Control | 2 LM            |           |
|                        |                 |           |

### Documentation

Provide your assessment of the kinds and amount of documentation that must be provided with the capability.

#### Example:

| Document Type                         | New/Update | Number of Pages |
|---------------------------------------|------------|-----------------|
| Requirements and Design Documentation | Update     | TBD             |

| Document Type             | New/Update | Number of Pages |
|---------------------------|------------|-----------------|
| Users Guide               | Update     | TBD             |
| API Interface Document    | N/A        | N/A             |
| Interface Design Document | N/A        | N/A             |
| Test Procedure            | Update     | TBD             |

**Assumptions**

None

**Open Issues**

None

**3. HWCI Assessments**

Not Applicable.